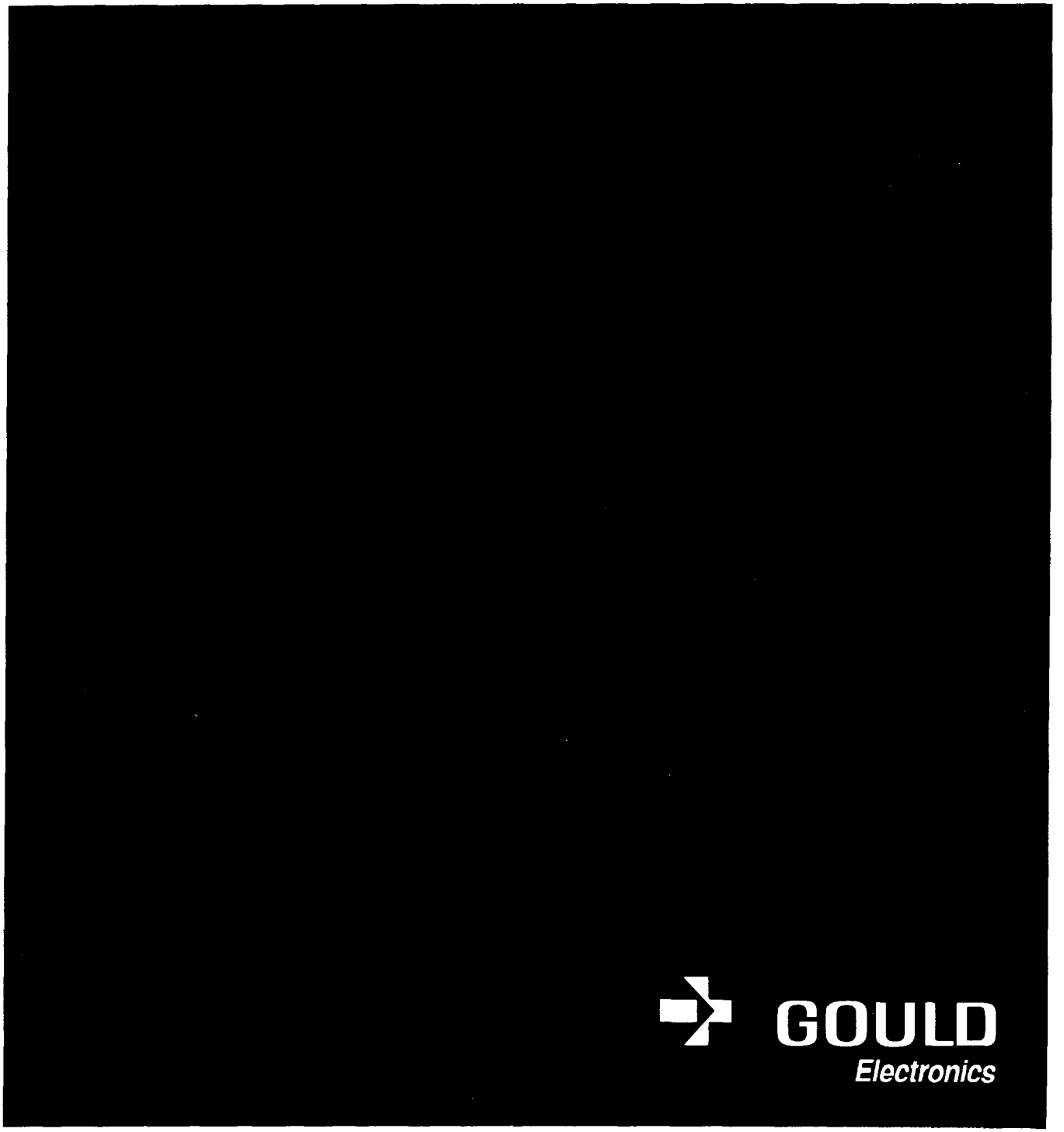
ML-J347-USE Rev A

Gould
Modbus J347 Interface

USER'S MANUAL



SUBJECT: Describes the installation and use of a J347 MODBUS Slave Interface, including a physical description, review of capabilities, installation procedures, electrical connections, and troubleshooting information.

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PREFACE

This manual describes the installation and use of the J347 MODBUS Slave Interface. This interface allows any model MODICON 184 or 384 PC to act as a slave device on a MODBUS communications system. The manual provides a description of the J347 interface, a review of capabilities, installation procedures, electrical connections, and troubleshooting information.

In this manual "J347" refers to the MODBUS Slave Interface. The product designation "J346" denotes a J347 interface, a J478 MODBUS modem and a cable, physically separate but packaged together.

Information on the MODBUS Industrial Communications System may be found in the following documents:

- MODBUS Industrial Communications System Product Description
- MODBUS System Planning Guide
- MODBUS Host Software Description

For information on specific system components (modems, interfaces, etc.), see the appropriate user manuals.

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The J347 MODBUS Slave Interface is a communications device which allows a 184 or 384 PC of any model to communicate over a MODBUS system network. The MODBUS master device (PC, computer, or intelligent terminal) initiates communications on a MODBUS system. The J347 interface simply "listens" for its slave address or for an address of zero (indicating a broadcast message). When the interface detects its own address, or a zero, the message will be processed. Otherwise it will be read but disregarded. The accepted message is checked for communications errors and invalid data. If the message is correct and complete, it is passed to the 184/384 PC. (The exceptions to this are messages which fetch counters held in the J347 interface.) If the message has errors or is invalid, the interface either disposes of the message and waits for retransmission or, in the case of certain errors, sends an error response to the master device.

When the 184/384 PC has processed the message, a response is passed to the J347 interface. (If the message received was a broadcast, the J347 does not send a response message to the MODBUS master.) A response message to a query is sent to the master device, which performs error checking and validation of the message.

The J347 interface supports the standard MODBUS messages shown in Table 1-1.

Table 1-1. MODBUS Messages Supported by J347 Interface

Function Code	Function Name	Description
01	Read Output Status	Get status (ON or OFF) of logic coils from a slave PC.
02	Read Input Status	Get status (ON or OFF) of discrete inputs from a slave PC.

Function Code	Function Name	Description
03	Read Holding Registers	Get the contents, in binary, of holding registers from a slave PC.
04	Read Input Registers	Get the contents, in binary, of input registers from a slave PC.
05	Modify Coil Status	Change the status (ON or OFF) of any coil in a slave PC. This command overrides the slave PC's memory protect and "disable coil" features.
06	Modify Register Content	Change the binary content of any output or holding register in the slave PC. (Input register content may not be changed.) This command overrides the slave PC's memory protect feature.
07	Read Exception Status	Get the status (ON or OFF) of eight fixed logic coils from a slave PC. User logic may be programmed to place PC status or control information in these coils, such as "machine ON or OFF", or "error conditions exist". This specially designed short message allows quick retrieval of status.
08	Loop Back Diagnostic Test	Used to test system communications. This message uses subfunction codes to retrieve diagnostic information held at the slave, start/stop the slave PC, access status counters, and identify possible communication faults.

Function Code	Function Name	Description
11	Fetch Event Counter	Get the content of a counter which keeps a total of successful message completions.
12	Fetch Communications Event Log	Get status information on communications, such as messages received or messages sent.
13	Program (All PC Types)	Allows the user to remotely program and alter logic in a slave PC. Subfunction codes are used to identify specific programming actions. Subfunctions 1 Start PC 2 Stop PC 3 Read 4 Write
14	Poll (All PC Types)	Allows the user to retrieve the response to a program message after the slave PC finishes processing the query. (This function is to be used only with function 13.)
15	Force Multiple Coils	Change the status (ON or OFF) of consecutive coils in a slave PC. This command overrides the slave PC's memory protect and "disable coil" features.
16	Preset Multiple Registers	Change the binary content of consecutive holding or output registers in the slave PC. (Input register contents cannot be changed.) This command overrides the slave PC's memory protect feature.
17	Report ID	Get the slave PC type and runlight status.

Indicator lights on the front of the interface allow the user to determine if the interface is working properly or if an error has been detected.

No operator action is required during normal operation. Once the unit is installed and connected, it is ready to act as a MODBUS interface.

The J347 interface is offered under the following product designations:

J347-001 - 184/384 PC Slave Interface

J346-0X1 - 184/384 PC Slave Interface, J478 Modem, 10 ft. interconnecting cable

J346-0X2 - 184/384 PC Slave Interface, J478 Modem, 30 ft. interconnecting cable

Note: X can be 1 (110 VAC, 60 Hz) or 2 (220 VAC, 50 Hz), indicating the type of modem included in the package.

Table 1-2 gives specifications for the J347 interface.

Table 1-2. J347 Interface Specifications

Physical	
Height - 15.00 in (381.00 mm) Width - 3.50 in (88.90 mm) Depth - 12.25 in (311.15 mm) Weight - 7.88 lbs. (17.34 kg)	
Environmental	
Ambient temperature Humidity	0 to 60°C 0 to 95% (noncondensing)
Power Requirements -	All required power is obtained from the 184/384 PC.

The J347 interface must be connected to a 184/384 PC and, if required, to a modem in order to act as a MODBUS slave interface. A J146 programming panel interface may be attached to the J347 interface. This must be done before the J347 interface is attached to the PC. Figures 2-1 through 2-4 show valid configurations. Devices shown in dotted lines are optional. For detailed installation instructions, see Section 3 of this manual.

Note that in all cases the J347 interface is connected directly to the 184/384 PC. The only device that can be attached to the left side of the J347 interface is the J146 programming panel interface. (The J146 interface allows a P140, P145, P150, or P155 programming panel to communicate with a 184/384 PC.)

NOTE: The I646 computer interface cannot be used with the J347 interface. If an I646 computer interface is required, the J347 interface must be disconnected from the 184/384 PC. This takes the PC off the MODBUS system.

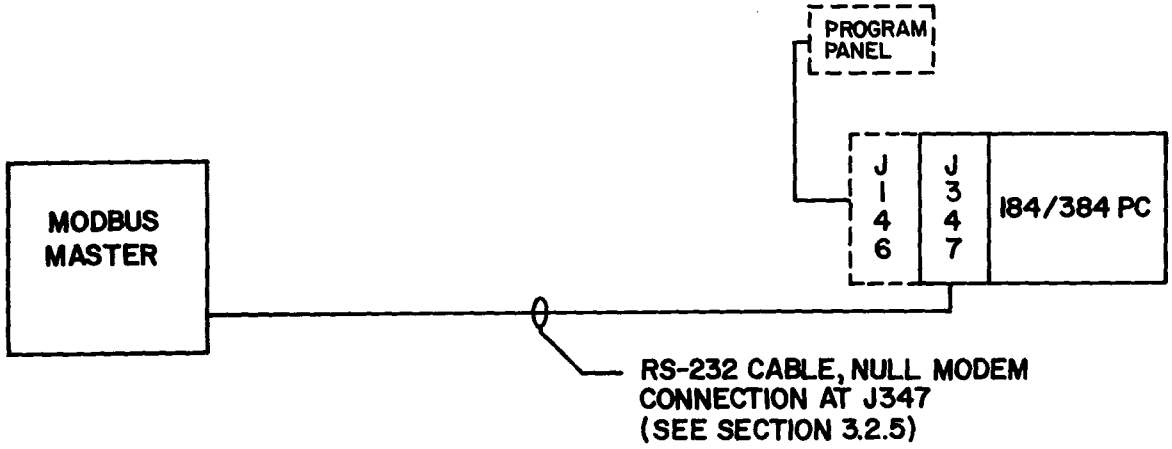


Figure 2-1. Point to Point Single Slave Configuration

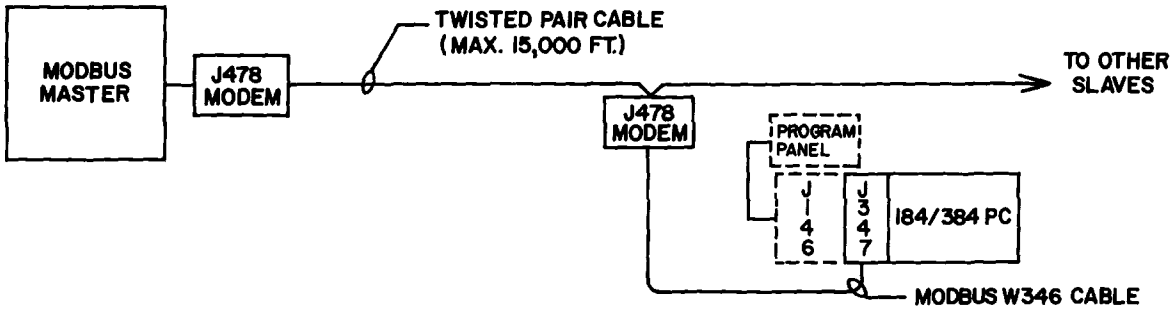


Figure 2-2. Daisy Chain (Zero Length Drop) Configuration Using J478 Modems

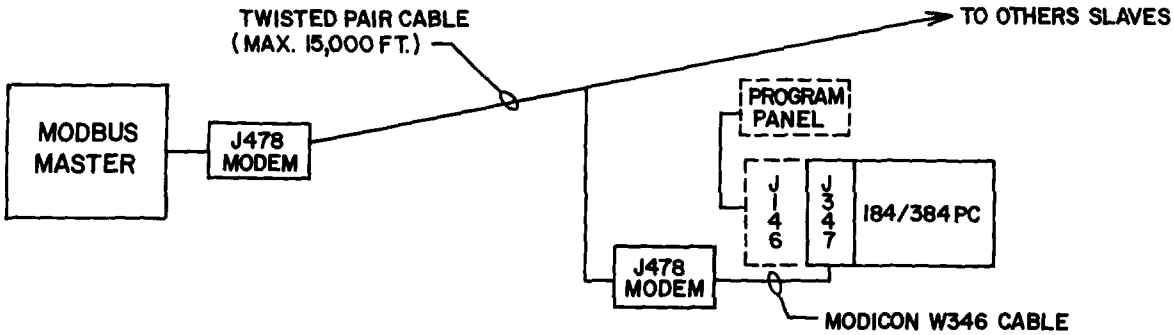


Figure 2-3. Multidrop Configuration Using J478 Modems

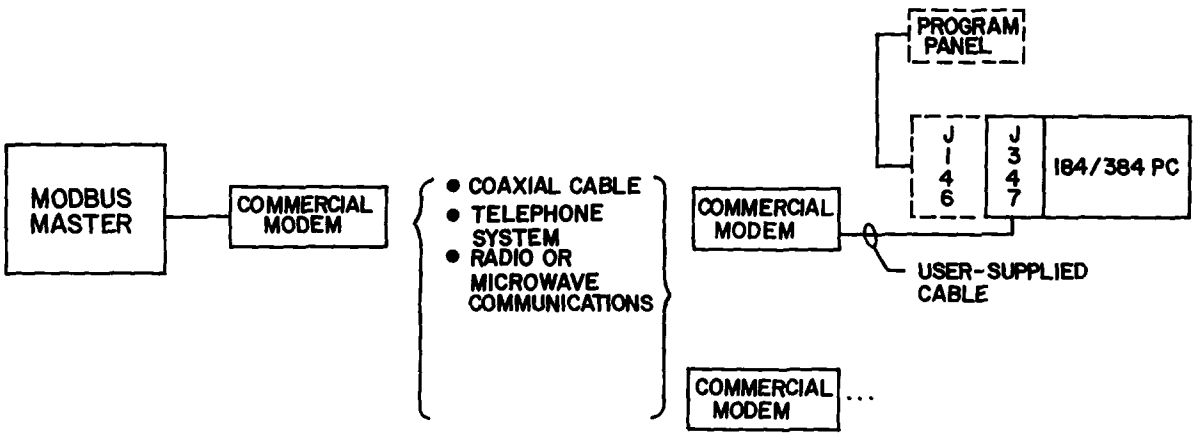


Figure 2-4. Multidrop Configuration Using Commercial Modems

The J347 interface is a drip proof, rugged unit that meets the same environmental specifications as the 184 and 384 PCs. Figure 3-1 shows the main physical features of the unit.

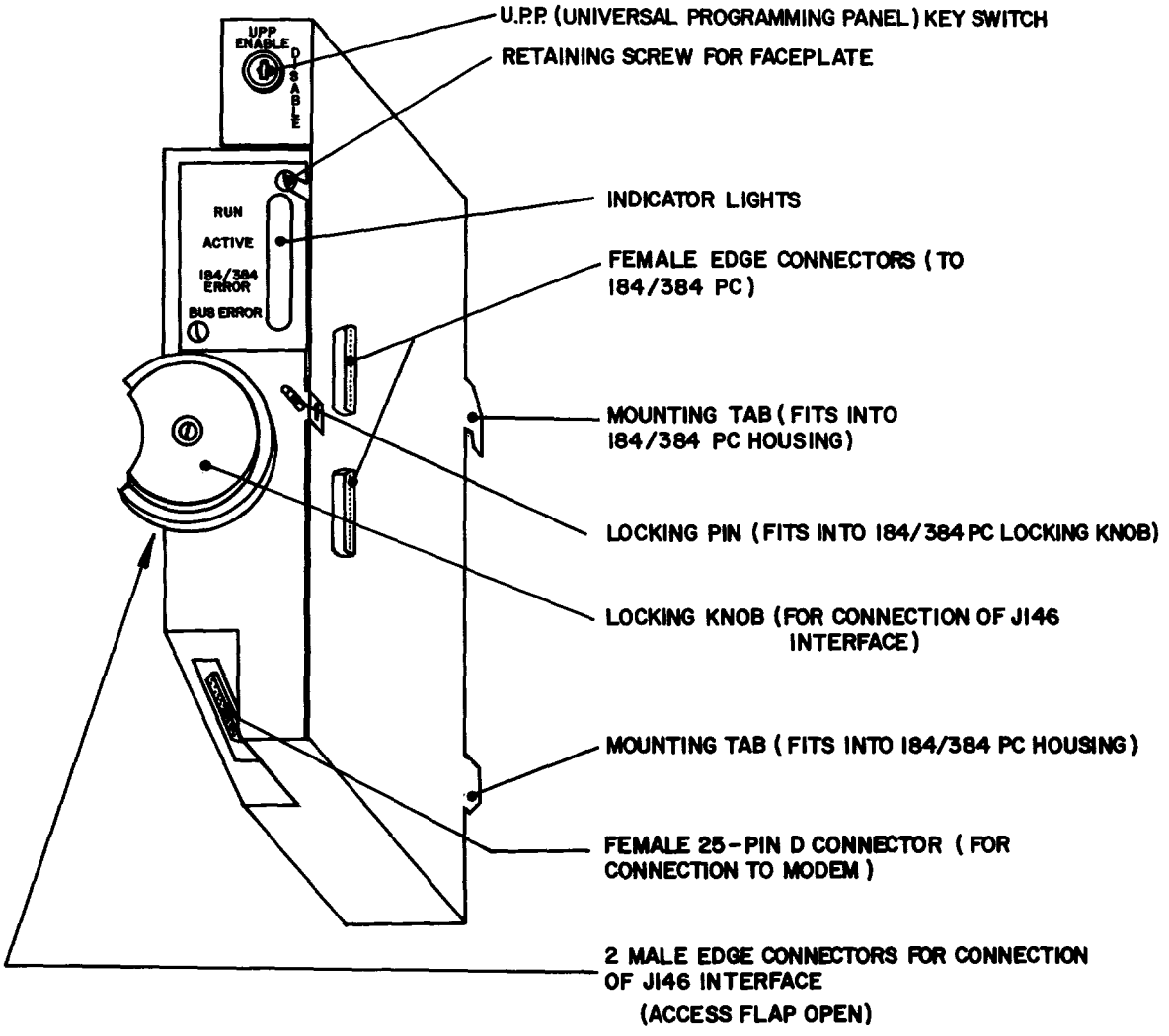


Figure 3-1. J347 Interface Physical Features

3.1 Switches and Controls

The J347 interface has the following switches and controls:

- U.P.P (Universal Program Panel) key switch
- Baud rate switch package
- Communication parameter switch package

•Address switch package

•Reset button

The U.P.P. key switch is located on the top front portion of the interface. The remaining switches and the reset button are located behind the indicator light faceplate on the front of the unit.

3.1.1 U.P.P. Key Switch

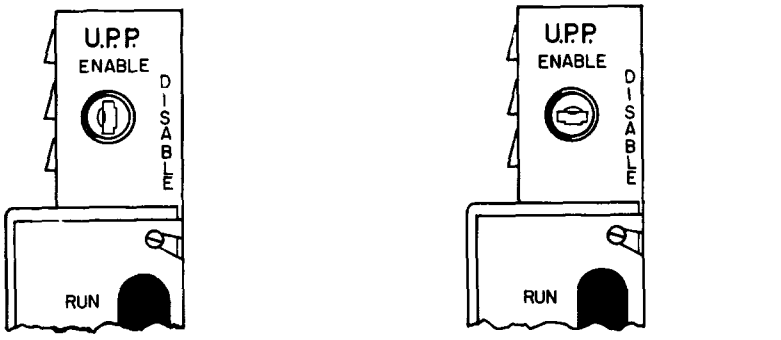
The U.P.P (Universal Program Panel) key switch controls program panel access to the controller's memory. This key switch is only used when a J146 programming panel interface is attached. The U.P.P. key switch must be set to "DISABLE" unless a programming panel is being used. Programming and MODBUS communications cannot take place at the same time. To allow the use of a program panel:

1) Turn the U.P.P. key switch to the "ENABLE" position.
2) The programming panel can now be used.

The J347 interface does not work as a MODBUS slave interface while the U.P.P. key switch is in the "ENABLE" position. To use the J347 interface after programming has been done:

1) Turn the U.P.P. key switch to the "DISABLE" position.
2) The J347 interface will now work as a MODBUS slave interface.

Figure 3-2 shows the ENABLE and DISABLE positions of the U.P.P. key switch.



U.P.P. KEY SWITCH IN ENABLE POSITION FOR PROGRAMMING

U.P.P. KEY SWITCH IN DISABLE POSITION FOR MODBUS OPERATION

Figure 3-2. U.P.P. Key Switch Positions

3.1.2 Baud Rate, Communication Parameter, and Address Switch Packages

Switch packages for the selection of baud rate, communication parameters, and slave address are located behind the moveable faceplate covering the indicator lights. To gain access to these switches:

1) Loosen, but do not remove, the faceplate's top screw.

2) Rotate the faceplate to the left.

3) The switches are located directly behind the top three indicator lights.

Figure 3-3 shows the location of the switch packages and how the faceplate is moved.

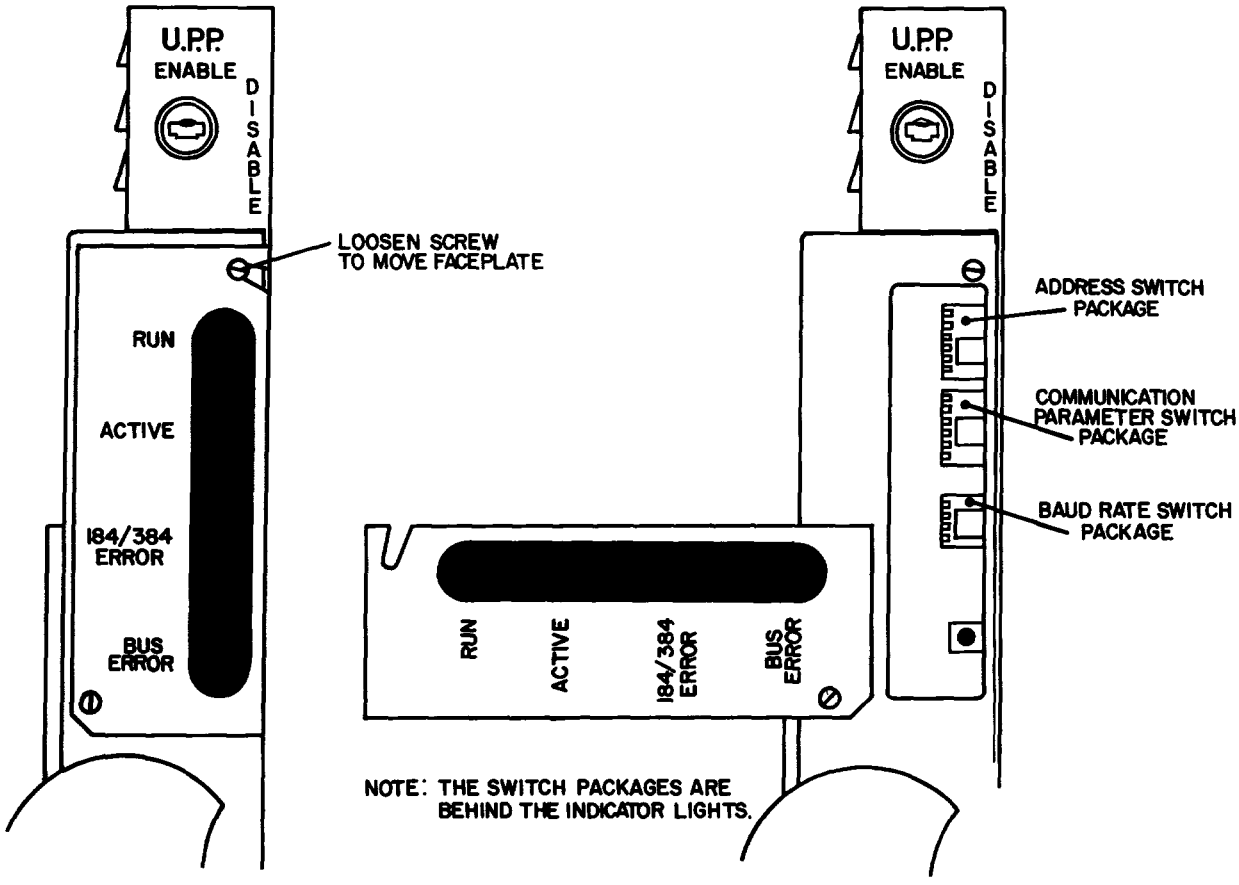


Figure 3-3. Switch Package Access and Location

The baud rate switch package allows the user to select a baud rate from 50 to 19.2K baud for MODBUS communications. The baud rate selected must match the baud rate of the other slaves on the MODBUS system.

The communication parameter switch package allows the user to enable or disable parity and to select the following:

- Number of stop bits (one or two)
- Even or odd parity
- Mode of transmission (RTU or ASCII
- Type of PC (184 or 384)

The stop bit, parity, and mode of transmission (unless test mode is selected) must match the other MODBUS slaves.

The address switch package allows the user to select the MODBUS slave address. This address must be different from any other slave address in a given MODBUS communication system.

Figure 3-4 shows switch numbering. Tables 3-1 through 3-3 give switch settings for the three switch packages.

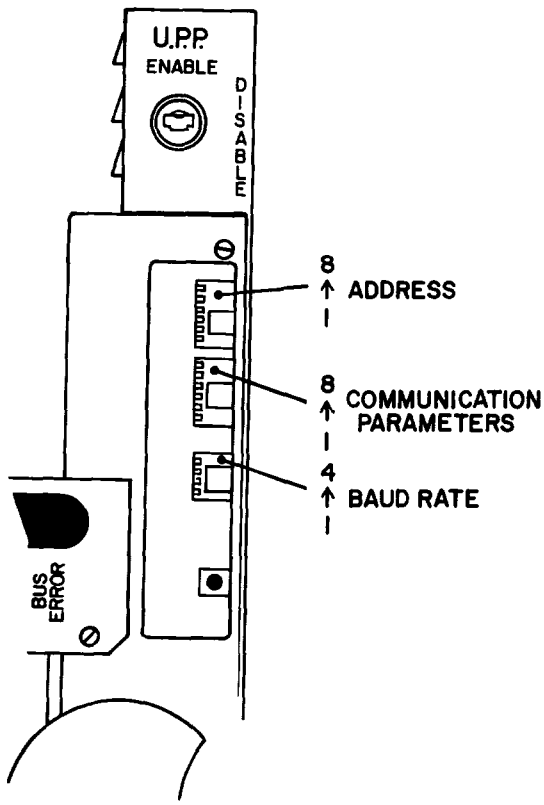


Figure 3-4. Switch Numbering

Setting an Address

To set a MODBUS slave address:

1) Choose a valid address (from 1 to 247), for example, 41.

2) Convert the address to an 8-bit binary number. Address 41 is 00101001.

3) Enter the binary number on the address switch package, zeros being OFF (switch down) and ones being ON (switch up). The number is entered "backwards" in that the rightmost switch (number one) is the least significant bit and the left-most switch (number eight) is the most significant bit.

   Table 3-1 shows sample address switch settings.

Table 3-1. Address Switch Settings

0 = OFF, Switch Down 1 = ON, Switch Up

Switch Number / Sample Address	8 (Addr. 128)	7 (Addr. 64)	6 (Addr. 32)	5 (Addr. 16)	4 (Addr. 8)	3 (Addr. 4)	2 (Addr. 2)	1 (Addr. 1)
1	0	0	0	0	0	0	0	1
5	0	0	0	0	0	1	1	0
9	0	0	0	0	1	0	0	1
35	0	0	1	0	0	0	1	1
72	0	1	0	0	1	0	0	0
112	0	1	1	1	0	0	0	0
154	1	0	0	1	1	0	1	0
247	1	1	1	1	0	1	1	1

Figure 3-5 shows switch packages set to some of the sample addresses.

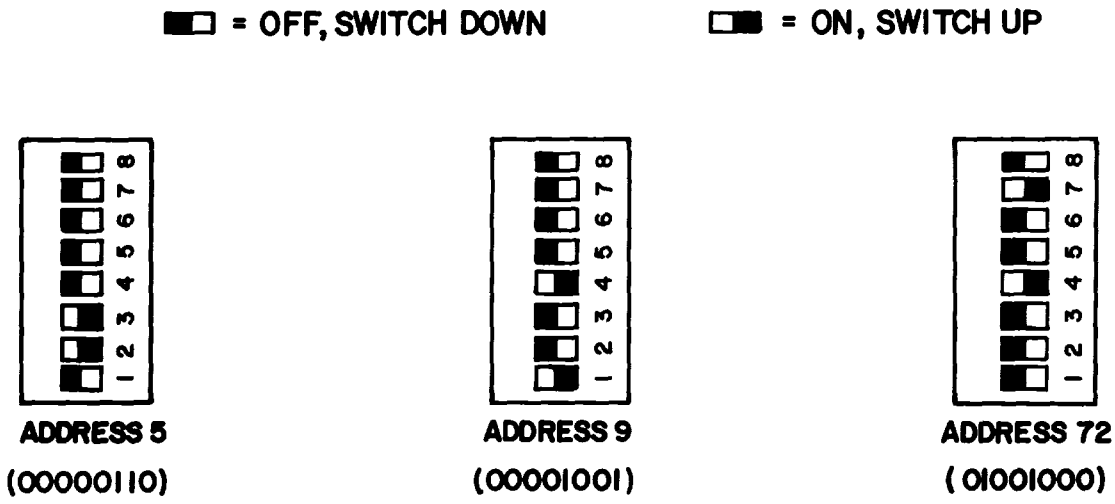


Figure 3-5. Sample Address Switch Settings

Setting Communication Parameters

Select the communication parameters according to Table 3-2 below.

Table 3-2 Communication Parameter Switch Settings

0 = OFF (Switch down) 1 = ON (Switch up)		
Switch Number	Parameter	Switch Setting
1	Stop Bits	1 = 1 stop bit 0 = 2 stop bits
2	Parity Enable/Disable	1 = enable parity 0 = disable parity
3	Even or Odd Parity	1 = even parity 0 = odd parity
4 and 5	Mode of Transmission	0,0 = ASCII mode 0,1 is not used 1,0 = RTU mode 1,1 = Test mode
6	-	Not used
7	Controller Type	1 = 384 PC 0 = 184 PC
8	-	Not used

Figure 3-6 shows switch packages set to some sample communication parameters.

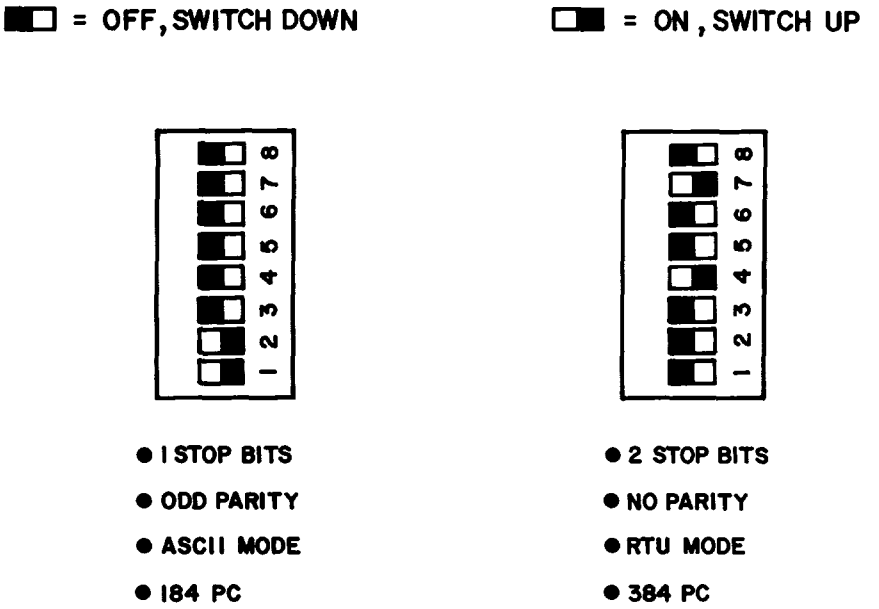


Figure 3-6. Sample Communication Parameter Switch Settings

Setting Baud Rates

1) Select the baud rate according to Table 3-3, below. There are four switches.

Table 3-3. Baud Rate Switch Settings

0 = OFF (Switch Down) 1 = ON (Switch Up)

Baud Rate	Switch No. 1	2	3	4
19.2K	1	1	1	1
9600	1	1	1	0
7200	1	1	0	1
4800	1	1	0	0
3600	1	0	1	1
2400	1	0	1	0
2000	1	0	0	1
1800	1	0	0	0
1200	0	1	1	1
600	0	1	1	0
300	0	1	0	1
150	0	1	0	0
134.5	0	0	1	1
110	0	0	1	0
75	0	0	0	1
50	0	0	0	0

Once the J347 is on, the switch package settings are read continuously. There is no need to turn the power off and on, or perform any other reset of the unit, if the switch package settings are changed. Any changes to switch setting, however, may prevent communication unless the rest of the network switch settings are in agreement.

CAUTION: All switch settings should be checked if the J347 interface is moved from one controller to another.

3.1.3 Reset Button

The reset button is located behind the address switch package (the topmost set of switches), as shown in Figure 3-7. When the reset button is pressed, the J347 interface goes through power up diagnostics (see Section 5). The J347 interface counters, event log, and diagnostic register are also cleared when the reset button is pressed, but the 184/384 PC is not effected.

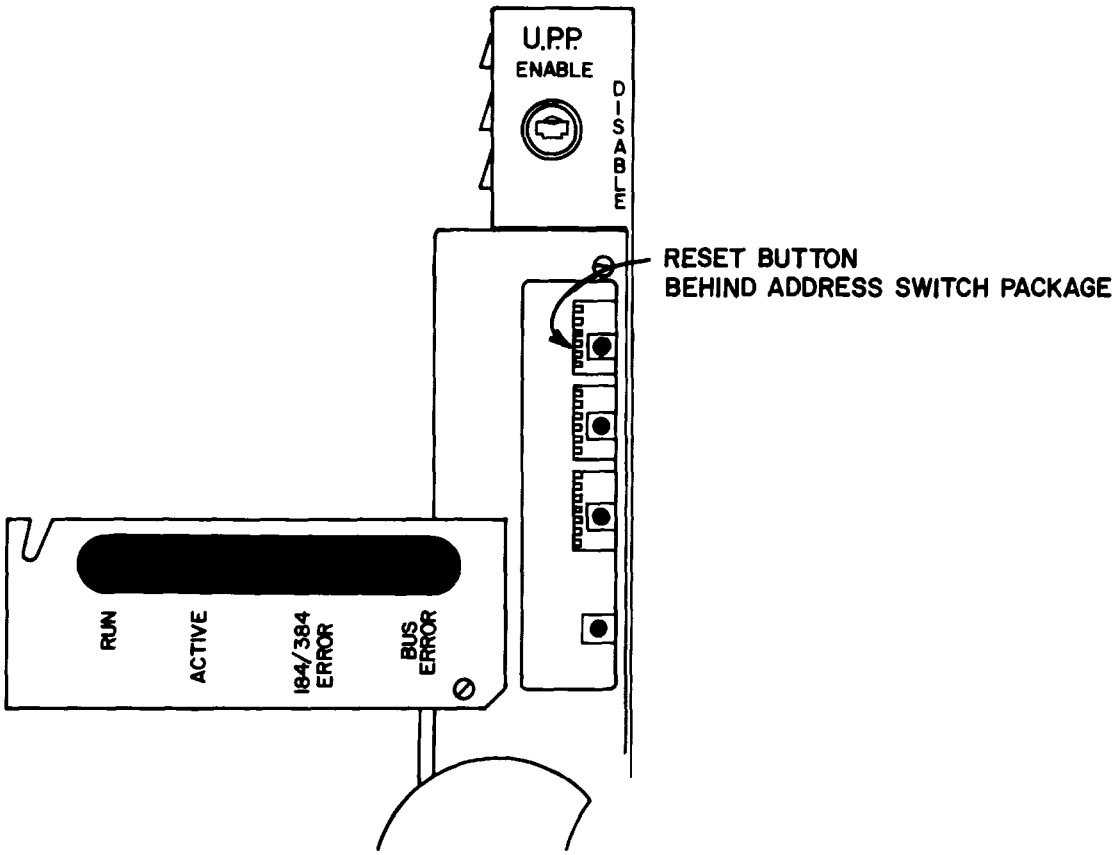


Figure 3-7. Reset Button Location

3.1.4 Indicator Lights

Four indicator lights are located behind the faceplate on the front of the J347 interface. They are labeled RUN, ACTIVE, 184/384 ERROR, and BUS ERROR. The indicator lights serve two purposes; they indicate the operational status of the unit and, if an error occurs when the unit is powered-up, they flash a specific error pattern. (See Section 5, Troubleshooting, for the definition of error patterns.) In an operational J347 interface, the indicator lights will function as follows:

RUN - On at all times during normal operation. Indicates that power-up diagnostic routines have been completed successfully. (This takes approximately five seconds.) This is the only light that should be on directly after power-up diagnostics have been run.

ACTIVE - On when interface receives a MODBUS message with its address (a query message) or an address of zero (a broadcast message). The light is turned off when the request is completed and a response is returned (or no response in the case of a broadcast message).

184/384 ERROR - Flashed once for each error in communications between the 184/384 PC and the J347 interface.

BUS ERROR - On when an error is detected in a MODBUS message received by the J347 interface. It stays on until a correct MODBUS message is received.

3.1.5 Connectors

There are three sets of connectors on a J347 interface:

- A pair of female edge connectors ("blue ribbon") for connection to the 184/384 PC, located on the right side of the J347 interface.
- A single female 25-pin D connector for connection to a modem, located on the underside of the interface.
- A pair of male edge connectors ("blue ribbon") for connection to a J146 programming panel interface, located on the left side of the J347 interface, under an access flap.

Figure 3-1 shows the location of these connectors.

3.2 INSTALLATION

The basic J347 interface installation steps are as follows:

- Set baud rate, communication parameter, and address switches
- Connect J146 programming panel interface to J347 interface (if necessary)
- Connect J347 interface to 384 PC
- Connect J347 interface to modem by cable (or connect to MODBUS master directly in single-slave, point-to-point configuration)

3.2.1 Switch Settings

Refer to Section 3.1.2 for switch setting instructions. Select the proper settings for the baud rate, communication parameter, and address switch packages.

3.2.2 Connecting the J347 Interface, J146 Interface, and the 184/384 PC

Figures 3-8 through 3-14 show connection of the J347 interface to a J146 programming panel interface and to a 184/384 PC.

1. Turn 184/384 PC locking knob counter clockwise to "OPEN". This frees the access flap. Fold the flap back so that it is flush with the PC housing. See Figure 3-8.

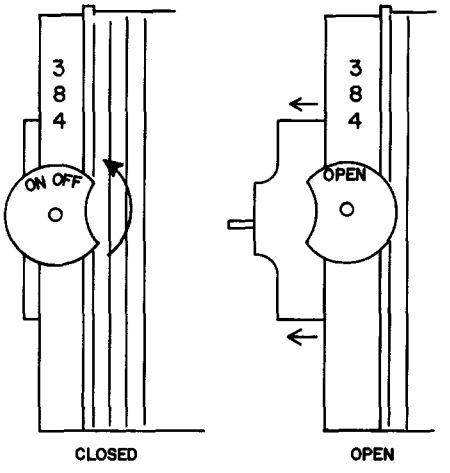


Figure 3-8. Open 184/384 PC Access Flap

2. Insert the mounting tabs on the back of the J347 into the 184/384 PC mounting flanges. Hook the top tab in first, then insert the lower tab. See Figure 3-9. If no J146 interface is to be connected, skip to Step 6. Also, see CAUTION before Step 5.

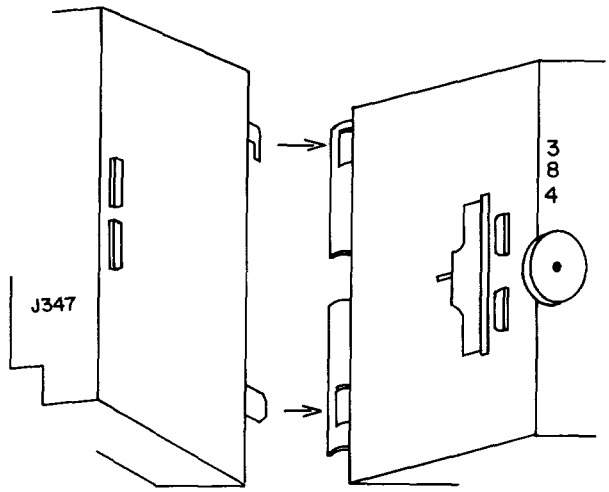


Figure 3-9. Mount J347 Interface on 184/384 PC

3. Turn the J347 locking knob counter clockwise until the access flap is free. Fold the flap back so that is is flush with the J347 housing. See Figure 3-10.

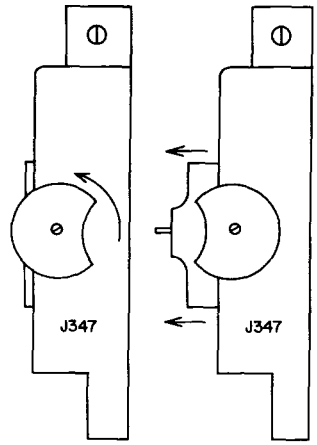


Figure 3-10. Open J347 Interface Access Flap

4. Insert the mounting tabs on the back of the J146 into the J347 mounting flanges. Hook the top tab in first, then insert the lower tab. See Figure 3-11.

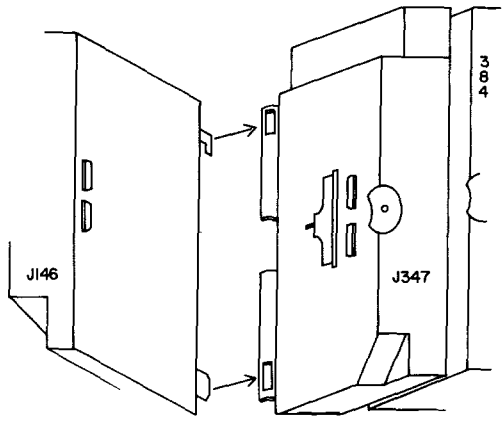


Figure 3-11. Mount J146 Interface on J347 Interface

CAUTION In Steps 5 and 6 make sure that the two sets of "D" connectors are properly seated before tightening the locking knob. Excessive force may result in damage to the connectors.

5. Engage J146 locking pin in the slot in the J347 locking knob. Once the pin is in the slot, turn the locking knob clockwise one-half turn. See Figure 3-12.

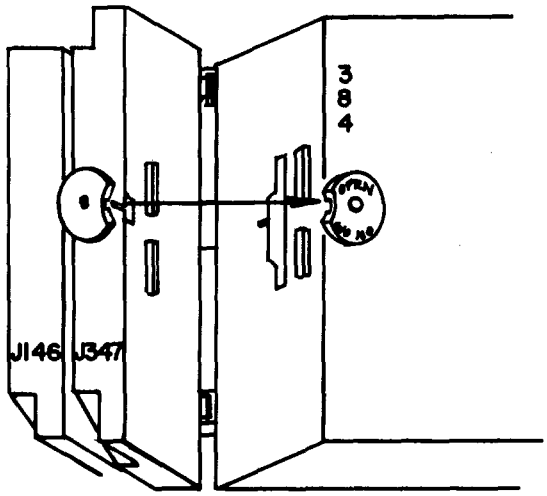


Figure 3-12. Connect J146 Interface to J347 Interface

6. Engage the J347 locking pin in the slot in the 184/384 PC locking knob. Once the pin is in the slot, turn the locking knob clockwise about one-half turn to the OFF position. See Figure 3-13.

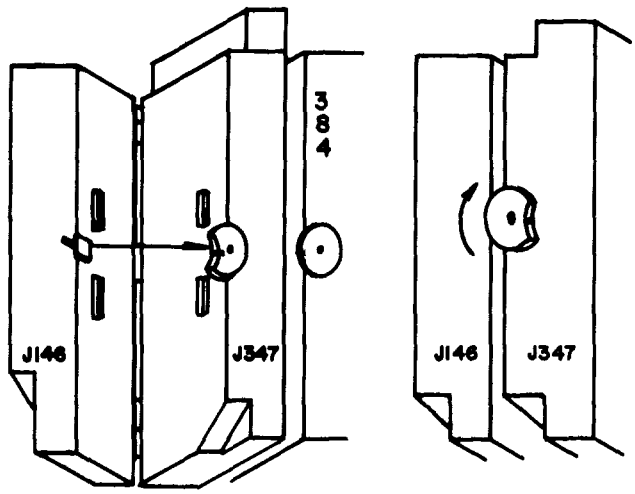


Figure 3-13. Connect J347 Interface to 184/384 PC

7. The units should fit together as shown. See Figure 3-14.

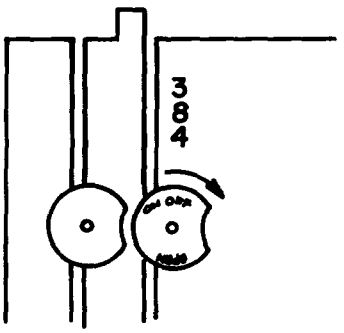


Figure 3-14. Completed Connection

8. When the 184/384 PC locking knob is turned to ON, power is supplied to the J347 interface and, if attached, to the J146 interface.

3.2.3 Connecting the J347 Interface to a Modem

If the J347 interface is to be connected to a J478 modem, a MODICON-supplied cable is used. This cable may also be used with some commercial modems, depending upon their required signals. If the required signals differ from those supported by the cable the user must supply a cable or modify the MODICON-supplied cable.

The MODICON-supplied cables are as follows:

AS-W346-010	10 foot long cable
AS-W346-030	30 foot long cable

Figure 3-15 shows the configuration ("pin-out") of these cables.

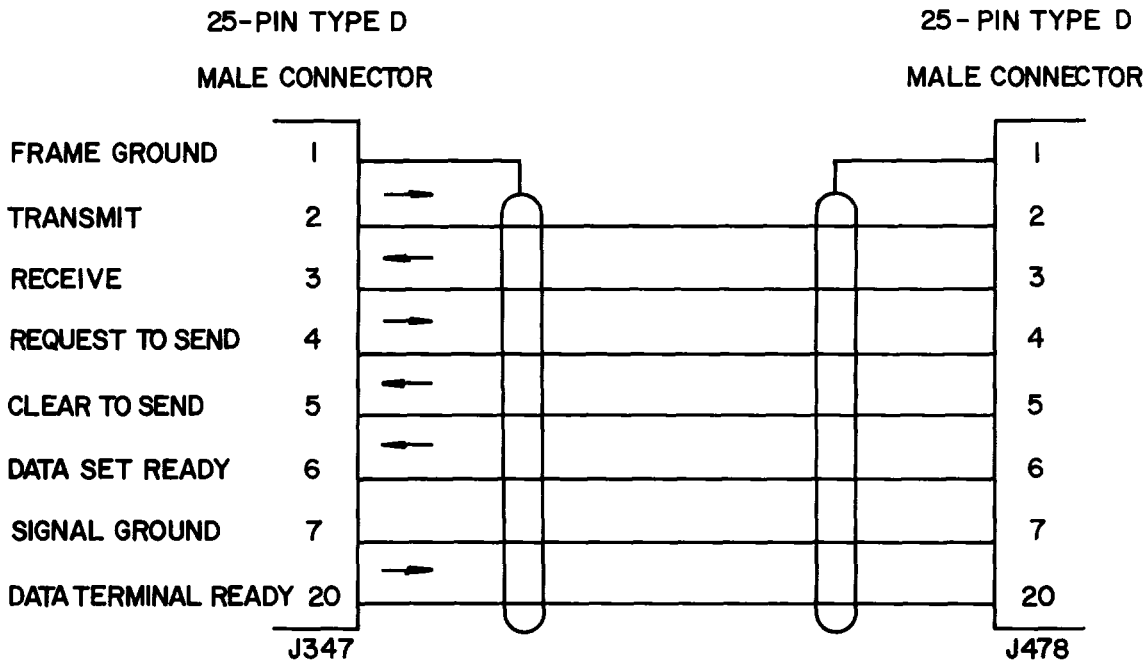


Figure 3-15. Pin-Out for AS-W346-0X0 Cable

Since the connection is direct and each end is terminated in a male D connector, the user does not need to identify the two ends to connect the cable. The cable may be attached at any time during the installation process. Make sure the slide latches on the connectors are used, to ensure a good connection.

3.2.4 Connecting the J347 Interface Directly to a 184/384 PC

If the J347 interface is used in a single slave, point-to-point configuration (see Figure 2-1), the user-supplied cable must be a "null modem connection". The required pin-out of the user-supplied cable is shown in Figure 3-16.

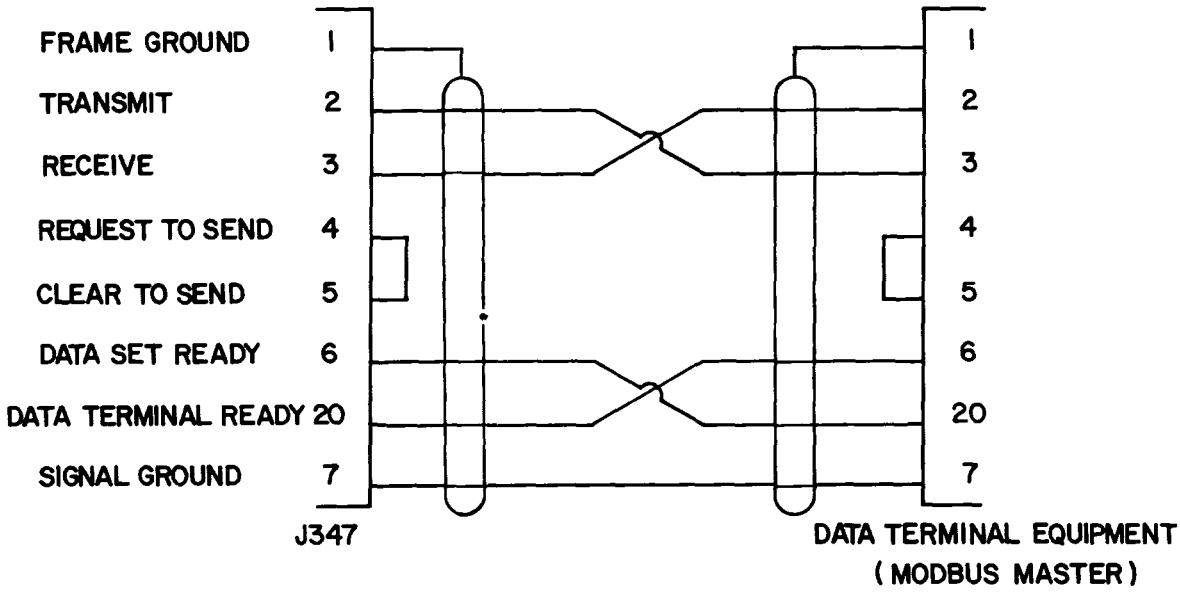


Figure 3-16. Pin-Out for Single Slave, Point-to-Point Connection

NOTE: If the connector at the MODBUS master is a 25-pin, Type D, male connector, a MODICON W364 cable can be used. The only difference between the W364 cable pin-out and the one shown above is that pins 6, 20, and 8 (Carrier Detect) are jumpered together at both ends. This should not affect signal transmission.

4.1 GENERAL OPERATION

Once the J347 interface is installed, it begins operating as soon as power is applied to the 184/384 PC and the PC is turned on. The J347 interface gets power directly from the 184/384 PC. The J347 interface cannot be installed while the 184/384PC is running. A complete set of diagnostic tests are performed:

- when power is first received from the 184/384 PC
- when the 184/384 PC is restarted after being stopped
- when the J347 reset button is pressed (the 184/384 PC is not reset)

It takes about 5 seconds for these tests to be run. If the tests are performed successfully (no errors found), only the RUN indicator light comes on. If other lights come on or no lights are lit, this indicates that an error has been found. At the same time, the appropriate bit in an internal register is set to indicate an error. See Section 5 for troubleshooting and error indication information.

4.2 MODES OF OPERATION

There are four modes, or operational states, that the J347 interface may enter. Each mode may be identified using the indicator lights on the front of the unit.

The only mode that is specifically selected by the user is Test Mode. The unit should otherwise be in On-Line Mode, indicating normal operation. Halt Mode and Listen Only Mode indicate errors in the J347 interface or elsewhere in the MODBUS system. The four modes may be described as follows:

- On-Line Mode - The RUN light is on continuously. This mode is entered during normal operation.
- Test Mode - This mode is used to test the internal operation of a J347 interface. All four indicator lights flash in sequence indicating continuous diagnostic tests are running. To enter this mode, set switches 4

and 5 on the communications parameter switch package to ON (switches up).

- Halt Mode - A fixed pattern of indicators flashes continuously, indicating a diagnostic test failure. This usually indicates that the J347 interface should be replaced. See Section 5 for indicator light error patterns.

- Listen Only Mode - The Run light is off, indicating a failure somewhere in the system. The user should take one of the following steps:

  1) Send a software restart signal (MODBUS function code 8, diagnostic code 01)

  2) Press the J347 interface reset button

  3) Cycle power to the associated 184/384 PC

  Any of these steps should cause the J347 interface to run diagnostic tests, then enter the On-Line Mode. If this doesn't happen, the J347 interface should be replaced.

4.3 J347 INTERFACE MODBUS MESSAGE RESPONSE TIME

Table 4-1 shows typical response times for a number of MODBUS messages. The response time is reached by adding preprocessing time (reading, validating, and reformatting the message), PC processing time, and post-processing time (getting the message ready to send to the MODBUS master). All times are shown in milliseconds.

Table 4-1. Response Times

Function Code	Message	Preprocessing[1] Time (mSec)	PC Processing Time (mSec)	Post Processing Time (mSec)	Respose (Time (mSec)
01	Read 1 coil	200	.2	1.4	201.6
01	Read 512 coils	200	1.7	37.7	239.4
02	Read 1 input	200	.2	1.4	201.6
02	Read 512 inputs	200	1.7	37.5	239.2
03	Read 1 holding Register	200	.2	1.5	201.7
03	Read 100 holding registers	200	6.6	52.3	258.9
04	Read 1 input register	200	.2	1.5	201.7
04	Read 100 input registers	200	6.6	52.2	258.8
05	Force 1 coil	200	.2	1.7	201.9
06	Set 1 register	200	.2	1.7	201.9
07	Read exception status	200	.2	1.7	201.9
13	Program (read 1 word)	200	.1	3.2	203.3
13	Program (read 16 words)	200	.9	11.3	212.2
15	Set 1 coil	200	.2	1.7	201.9
15	Set 511 coils	200	4.5	1.7	206.2
16	Set 1 holding register	200	.2	1.7	201.9
16	Set 32 holding registers	200	2.3	1.7	204.0
17	Report ID	200	2.0	603.0[2]	805.0

[1] Preprocessing is done during the scan. The worst case scan figures are used.

[2] Function code 17 takes three scans to complete. Three worst case scan times of 200 mSec are used.

5.1 MAINTENANCE

The J347 interface requires no periodic maintenance. The unit is designed to meet the same environmental specifications as the 184/384 PC.

5.2 TROUBLESHOOTING

There are three types of possible problems in a MODBUS system, as shown below:

- Communications errors - Handled through automatic message retries.
- Incomplete message processing due to an exception condition - handled through the return of an exception response to the user.
- Diagnostic test failure in the interface unit - handled by alerting the user to the failure through the indicator light "halt patterns".

The handling of communications errors and exception conditions does not involve troubleshooting at the J347 interface. Therefore, this section deals with indicator light "halt patterns" and provides a troubleshooting table.

5.2.1 Indicator Light Halt Patterns

Whenever an error is encountered during a diagnostic test, the J347 interface stops, enters Halt Mode, and flashes a specific halt pattern on the indicator lights. This can indicate that the J347 interface should be replaced. The halt pattern should be noted and the information given to the repair facility if the unit is returned. Table 5-1 defines the various halt patterns.

Table 5-1. Halt Patterns

0 = Light off 1 = Light flashing			
RUN	ACTIVE	184/384 ERROR	BUS ERROR
0	0	0	0 Not used
0	0	0	1 RUN light error
0	0	1	0 T-bus failed
0	0	1	1 MODBUS test failed
0	1	0	0 Timer 0 test failed
0	1	0	1 Timer 1 test failed
0	1	1	0 Timer 2 test failed
0	1	1	1 ROM chip 0 test failed
1	0	0	0 Not used
1	0	0	1 ROM chip 1 test failed
1	0	1	0 ROM chip 2 test failed
1	0	1	1 ROM chip 3 test failed
1	1	0	0 RAM chip 5000-53FF test failed
1	1	0	1 RAM chip 6000-67FF test failed (even addresses)
1	1	1	0 RAM chip 6000-67FF test failed (odd addresses)
1	1	1	1 Not used

5.2.2 Troubleshooting Table

The following table lists types of failures, possible causes, and corrective action.

Table 5-2. Troubleshooting Table

Failure	Possible Cause	Corrective Action
Lights indicate continuous diagnostic test running	• Communication parameter switch package set for test mode operation, switches 4 and 5 ON (switch up).	• Check switch settings and reset switches to desired setting. (See Section 3.1.2.)
	• Failed J347.	• Replace J347.
Incorrect or no response, but RUN and ACTIVE lights do not indicate problem	• U.P.P. key switch set to ENABLE.	• Set U.P.P. key switch to DISABLE, using procedure in Section 3.1.1.
	• MODBUS master device sending broadcast messages.	• No action necessary. Broadcast messages are not responded to by slave devices.
Use of J347 causes PC RUN light to to out	• Failed J347.	• Replace J347.
ACTIVE light does not go on	• Incorrect J347 parameter settings.	• Check switch packages for correct settings. See Section 3.1.2.
	• Cable not connected or incorrect cable used.	• Check cable seating and check cable part number.
	• Failed J347.	• Replace J347.
ACTIVE light is only light on (blinking or steady)	• J347 is in LISTEN ONLY mode.	• Send software restart using MODBUS protocol (function code 8, diagnostic code 1).
		• Press J347 reset button.
		• Cycle power to PC (this resets the PC).
	• Diagnostic test failed.	• Replace J347.

Failure	Possible Cause	Corrective Action
J347 indicator lights flashing pattern (RUN light not on continuously)	• Failed J347.	• Send software restart using MODBUS protocol (function code 8, diagnostic code 1). or • Press J347 reset button. or • Cycle power to PC (this resets the PC). • If pattern persists, check Table 5-1 to identify halt pattern, then replace J347.

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